3.5 Geology and Soils

This analyzes the proposed project's and non-clustered scenario's impacts related to geology and soils, and proposes mitigation measures as needed. The following setting and analysis is based on various resources including *Geotechnical Input in Support of the Environmental Impact Report – Saddle Crest Parcel* prepared by Pacific Soils Engineering, Inc. (see Appendix F).

3.5.1 Environmental Setting

Regulatory Framework

Earthquake Hazards Reduction Act

The Earthquake Hazards Reduction Act was enacted in 1997 to "*reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards and reduction program*." To accomplish this, the Act established the National Earthquake Hazards Reduction Program (NEHRP). This program was significantly amended in November 1990 by NEHRP, which refined the description of agency responsibilities, program goals, and objectives.

NEHRP's mission includes improved understanding, characterization, and prediction of hazards and vulnerabilities; improvement of building codes and land use practices; risk reduction through post-earthquake investigations and education; development and improvement of design and construction techniques; improvement of mitigation capacity; and accelerated application of research results. The NEHRP designates the Federal Emergency Management Agency (FEMA) as the lead agency of the program and assigns it several planning, coordinating, and reporting responsibilities. Programs under NEHRP help inform and guide planning and building code requirements such as emergency evacuation responsibilities and seismic code standards such as those to which the proposed project would be required to adhere.

California Building Code

The California Building Code (CBC) has been codified in the CCR as Title 24, Part 2. Title 24 is administered by the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. Under state law, all building standards must be centralized in Title 24 or they are not enforceable. The purpose of the CBC is to establish minimum standards to safeguard the public health, safety and general welfare through structural strength, means of egress, and general stability by regulating and controlling the design, construction, quality of materials, use and occupancy, location, and maintenance of all building and structures within its jurisdiction. The CBC is based on the International Building Code (IBC; previously known as the Uniform Building Code) published by the International Code Conference. In addition, the CBC contains necessary California amendments, which are based on the American Society of Civil Engineers (ASCE) Minimum Design Standards 7-05. ASCE 7-05 provides requirements for general structural design and includes means for determining earthquake loads as well as other loads (flood, snow, wind, etc.) for inclusion into building codes. The provisions of the CBC apply

to the construction, alteration, movement, replacement, and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures throughout California.

The earthquake design requirements of the CBC take into account the occupancy category of the structure, site class, soil classifications, and various seismic coefficients, which are used to determine a Seismic Design Category (SDC) for a project. The SDC is a classification system that combines the occupancy categories with the level of expected ground motions at the site and ranges from SDC A (very small seismic vulnerability) to SDC E/F (very high seismic vulnerability and near a major fault). Design specifications are then determined according to the SDC. All constructed elements of the project are subject to seismic design requirements of the CBC.

Orange County General Plan – Safety Element

The following goal and policies are contained within the Orange County General Plan that would apply to the proposed project.

Goal 2 Minimize the effects of public safety hazards through implementation of appropriate regulations and standards which maximize protection of life and property.

Objective 2.1: To create and maintain plans and programs which mitigate the effects of public safety hazards.

Objective 2.2: To encourage the development and utilization of technologies that minimize the effects of public safety hazards.

Foothill/Trabuco Specific Plan

The F/TSP includes grading, drainage, and site planning guidelines to ensure a comprehensive approach to grading and site planning. These guidelines encourage development to be sensitive to existing geologic hazards. The following area-wide objectives relate to the proposed project:

3) Development Potential:

   a) Provide some development potential (minimum of one dwelling unit) on each existing building site except for extreme situations where public health and safety concerns would preclude development of a site. For example, some building sites may be un-developable due to: 1) the site's location entirely within a floodplain where flood hazards cannot be adequately mitigated; 2) the lack of suitable legal access, 3) dependence on a septic system on a site which cannot percolate; or 4) severe topographic or geotechnical constraints. No building sites will be specifically designated as un-developable by the Specific Plan Land Use Plan and Land Use District Regulations, however, the ability of each site to be developed will be evaluated as part of an areas plan and/or site development permit.

b) Ensure that property owners have a right to develop each property through development regulations and guidelines which do not preclude development, but which do not necessarily guarantee that all existing building sites may be developed (i.e., where there are extreme public health and safety concerns) or that they may be further subdivided.

Existing Conditions

The project site is a located in the northeastern portion of unincorporated Orange County and is vacant with evidences of some disturbance due to the 2007 wildfire, and intermittent grazing by neighboring livestock. Remnants of access roads that were used during previous mining attempts and for access during previous geotechnical investigations remain throughout the site. The previous mining attempts appear to be focused in a narrow band in the southeastern portion of the site; however, the mining does not appear to be extensive and there is no remaining mining equipment.

As shown in **Figure 3.5-1**, the topography of the site is diverse, and it can be divided into a southwestern parcel and a northeastern parcel. The southwestern parcel of the site is characterized by northwest-southeast trending hills separated by a relatively large valley. There is also a gently sloping planar area that connects the two hills in the northwest part of this parcel. The irregular shaped western edge of the parcel consists of a relatively large, gentle sloping canyon.

The northeastern parcel of the site is dominated by a generally north trending canyon along the western edge and a single ridge along the eastern portion. The very southern edge of this partial has a generally east-west trending canyon.

The elevations of the site range from approximately 1,200 feet at the southern corner of the site, to approximately 1,800 feet along a ridgeline in the northeastern portion of the site.

Regional Faults

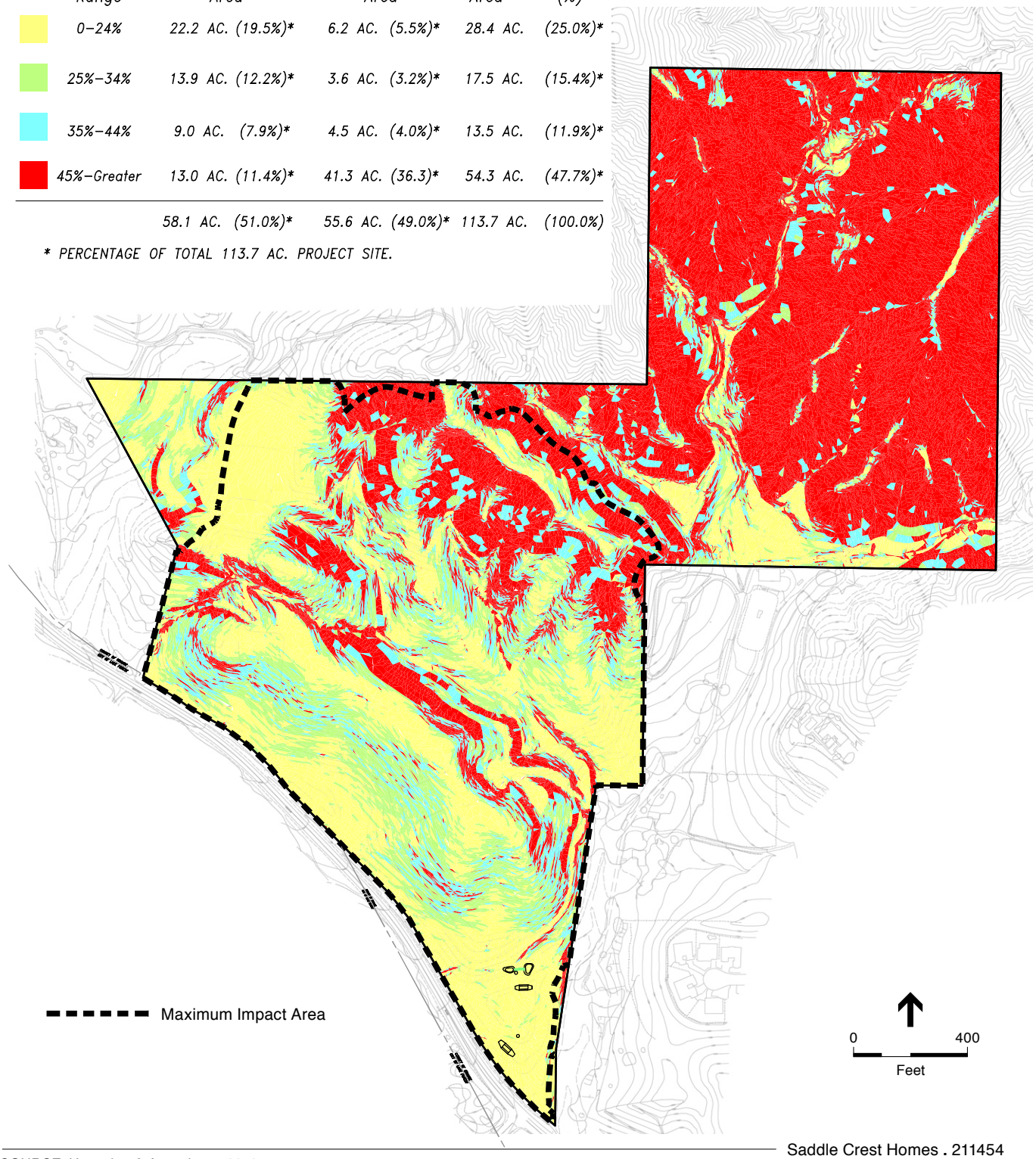
There are several large active faults in the Southern California region surrounding the project site. The prominent active fault systems are the San Joaquin Hills Thrust, Newport-Inglewood, Whittier-Elsinore, and San Andreas Fault.

The San Joaquin Hills Trust Fault system extends from San Clemente State Beach to the Santa Ana River. The maximum magnitude (Mw) earthquake for this fault is estimated at 6.6. The nearest distance from the project site to the projection of the postulated rupture area along the fault trace is approximately seven miles.

The Whittier-Elsinore Fault system is located approximately ten miles north of the site. The Whittier Fault is the main spur of the Whittier-Elsinore Fault System and extends northwest from the Santa Ana Canyon through the Puente Hills to the Santa Monica Mountains. The Whittier Fault system is a right-lateral reverse fault that dips to the northeast.

Slope Range	Developed Area	Undeveloped Area	Total Area	(%)*
0–24%	22.2 AC. (19.5%)*	6.2 AC. (5.5%)*	28.4 AC.	(25.0%)*
25%–34%	13.9 AC. (12.2%)*	3.6 AC. (3.2%)*	17.5 AC.	(15.4%)*
35%–44%	9.0 AC. (7.9%)*	4.5 AC. (4.0%)*	13.5 AC.	(11.9%)*
45%–Greater	13.0 AC. (11.4%)*	41.3 AC. (36.3)*	54.3 AC.	(47.7%)*
	58.1 AC. (51.0%)*	55.6 AC. (49.0%)*	113.7 AC.	(100.0%)

* PERCENTAGE OF TOTAL 113.7 AC. PROJECT SITE.



SOURCE: Hunsaker & Associates, 2012.

Saddle Crest Homes . 211454

Figure 3.5-1
Slope Analysis Map

The Newport-Inglewood Fault system is located approximately 16 miles southwest of the site. This fault system extends northwest from a point approximately five miles offshore of Laguna Beach to the Santa Monica Mountains. This fault system is characterized by a series of sub-parallel faults, which exhibit considerable offset with only minor evidence of surface displacement.

The San Andreas Fault system is located approximately 38 miles northeast of the site. This fault extends northeast from the Mexican border to Point Arena where it continues offshore before turning to the west in the vicinity of Cape Mendocino. The San Andreas is the major structural feature in California and defines a boundary between the Pacific and North American tectonic plates.

Due to the length and complexity of this fault system, it has been divided into sections on the basis of general trend. The southern portion of the fault system, which extends from the Gulf of California to the Transverse Range, is the closest to the project site. Displacement along this section is right-lateral.

Fault Rupture

Surface rupture occurs when movement on a fault deep within the earth breaks through to the surface. Fault ruptures almost always follow pre-existing faults that are zones of weakness. Rupture may occur suddenly during an earthquake or slowly in the form of fault creep. Sudden displacements are more damaging to structures, because they are accompanied by shaking. Fault creep is the slow rupture of the earth's crust. No active faults have been identified on or within seven miles of the project area.

Seismic Hazards

Seismicity is the geographic and historical distribution of earthquakes, including their frequency, intensity, and distribution. Seismic hazards include surface rupture, ground shaking, liquefaction, landslides, subsidence, expansive soils, and soils and soil erosion. The Southern California area is tectonically active, and known to be subject to seismic hazards. Potential hazards stemming from local and regional earthquakes may be primary, such as surface rupture and ground motion, or secondary, such as liquefaction and seismically induced slope failures.

Ground Shaking

The Southern California region is characterized by, and has a history of, faults and associated seismic activity. Earthquakes are classified by their magnitude, a measure of the amount of energy released during an event. During a seismic event, the project sites may be subjected to high levels of ground shaking due to its proximity to active faults in the area. The largest fault in the area is the San Andreas fault, which is considered active. The San Andreas fault's most recent seismic event within the project vicinity occurred in 1857, resulting in approximately 200 feet of horizontal movement along the main trace of the fault.

Landslides

Three landslides have been mapped within the property boundary (Pacific Soils Engineering, 2010). Each of these appear to relatively shallow, and are probably the result of single or multiple debris flow type events that result from the down slope movement of highly weathered, near surface bedrock and soils. These landslides probably occurred during periods of intense rainfall activity.

Expansive Soils

Expansive soils generally result from specific clay minerals that expand in volume when saturated and shrink in volume when dry. The presence of this soil type can damage structures when expansion and contraction of soil cracks rigid building materials (i.e., concrete, wood, drywall, etc.). The geotechnical investigation of the site determined that on-site soils were found to have mostly a low to moderate potential for expansion (Pacific Soils Engineering, 2010). However, there may be isolated areas with higher expansive properties (Pacific Soils Engineering, 2010).

On-site Soils

Surface soils on-site include undocumented artificial fill, colluviums alluvium, terrace deposits, and landslide debris. These relatively shallow deposits of soil overlie bedrock of the Santiago, Silverado, Williams and Ladd Formations. **Table 3.5-1** contains descriptions of these soils.

TABLE 3.5-1
ON-SITE SOILS

Name of Formation	Location	Description	General Engineering Properties
Undocumented Artificial Fill (afu)	Throughout the site at a depth of 2 to 25 feet.	Silty, gravelly sand, and sandy gravel, brown, loose to dense.	Highly collapsible, significantly compressible, low to very low expansion potential, negligible soluble sulfate potential, low to moderate potential for liquefaction.
Colluvium (Qcol)	In areas with slope wash, present from ground surface to 3 or 15 feet below surface.	Sandy silt and sandy clay, brown to dark brown, firm to soft.	Highly collapsible, significantly compressible, medium to very low expansion potential, negligible soluble sulfate potential, low potential for liquefaction.
Alluvium (Qal)	At the bottom of larger canyons, to a depth of approximately 15 feet.	Sandy gravels and cobbles with silt and/or sand lenses, brown to gray-brown, loose to dense.	Collapsible, significantly compressible, low to very low expansion potential, negligible soluble sulfate potential, may be susceptible to liquefaction.
Landslide Deposits (Qls)	In the southern parcel on a slide slope to the main canyon. In the northern parcel on steeper slopes as shallow debris flows.	Intermixed bedrock derived debris and colluvial deposits. Sand, gravel, silt, brown to tan, loose, blocky.	Collapsible, compressible, low to moderate expansion potential, unstable slopes, locally saturated.

TABLE 3.5-1
ON-SITE SOILS

Name of Formation	Location	Description	General Engineering Properties
Terrace Deposits (Qt)	In the central and western edge of the southern parcel.	Silty sand to sandy silt with local clayey zones and occasional cobbles, layered to laminated.	Generally not susceptible to hydro-collapse and not significantly compressible, low expansion potential, negligible soluble sulfate potential, low potential for liquefaction.
Santiago Formation (Tsa)	In the southwestern corner, locally overlain by surficial deposits.	Primarily medium to course grained sandstone, silty sandstone, and occasional siltstone or shale layers, mostly yellow-gray, moderately hard to hard, moderately cemented.	Generally not susceptible to hydro-collapse and not significantly compressible, negligible soluble sulfate potential, low potential for liquefaction.
Silverado Formation (Tsi)	In the subsurface in most of the southwestern portion of the site. It is orverlain by surficial deposits, including alluvium, colluvium, terrace deposits and landslide deposits.	Sandstone and siltstone, medium to course grained silty sandstone, pebble and cobble conglomerate, and occasional carbonaceous shale, mostly yellow-gray, moderately hard to hard, moderately cemented.	Generally not susceptible to hydro-collapse and not significantly compressible, negligible soluble sulfate potential, low potential for liquefaction.
Williams Formation – Pleasants Sandstone Member (Kwp)	In the southwestern and northeastern portions of the site. Locally overlain by artificial fill and landslide deposits.	A fine-grained shaly, silty sandstone interbedded with calcareous sandstone and medium to fine grained sandstone. Generally, poorly bedded to massive and hard to very hard.	Generally not susceptible to hydro-collapse and not significantly compressible, negligible soluble sulfate potential, low potential for liquefaction.
Williams Formation – Shultz Ranch Member	In the central portion of the northern parcel of the site.	Sandstone member consists of coarse-grained sandstone to conglomerate, siltstone and silty sandstone, massively bedded and often cross-bedded.	Generally not susceptible to hydro-collapse and not significantly compressible, negligible soluble sulfate potential, low potential for liquefaction.
Ladd Formation-Holz Shale Member	In the northeast corner of the site.	A marine silty shale with minor interbedded lenses of conglomerate, silty sandstone, and conglomerate sandstone. Typically poorly to irregularly bedded in the shale portions and massively where it is a sandstone or conglomerate.	Generally not susceptible to hydro-collapse and not significantly compressible, negligible soluble sulfate potential, low potential for liquefaction.

SOURCE: Pacific Soils Engineering, 2010.

3.5.2 Thresholds of Significance

According to Appendix G of the *CEQA Guidelines* and the County of Orange Environmental Analysis Checklist, a project would have a significant adverse effect on geology and soils resources if it would:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death, involving:
  - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault,
  - Strong seismic ground shaking,
  - Seismic-related ground failure, including liquefaction, or
  - Landslides;
- Result in substantial soil erosion or the loss of topsoil;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;
- Be located on expansive soil, as defined in Table 18-1-B of the California Building Code (2010), creating substantial risks to life or property; or
- Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems in areas where sewers are not available for the disposal of wastewater.

The following is a discussion of the potential effects of the proposed project and non-clustered scenario from geology and soils, according to the key issue areas identified in Appendix G of the *CEQA Guidelines*. The proposed project and non-clustered scenario would connect to existing sewers lines and would not require septic or alternative wastewater disposal systems and as discussed in the NOP/Initial Study; therefore would have no impact related to this criterion (see Appendix A.1). Additionally, no public comments were received regarding these thresholds during the 30-day NOP/Initial Study public scoping period. Therefore, no further analysis of the significance criteria regarding septic tanks is included in the EIR.

3.5.3 Methodology

Potential significant impacts associated with the proposed project were identified based on a review of existing literature as well as site reconnaissance, and testing conducted by Pacific Soils Engineering (see Appendix F). The geotechnical report prepared by Pacific Soils Engineering presented findings, conclusions, and recommendations concerning development of the project sites based on the engineering analysis of geotechnical properties of the subsurface conditions, evaluation of geotechnical properties of soils, and a summary of findings, conclusions, and recommendations. The sections that follow discuss the identified impacts and the measures that would be incorporated to mitigate significant impacts.

3.5.4 Project Design Features

The following project design features have been included for the proposed project and some would also apply to the non-clustered scenario. All project design features will be included in the Mitigation Monitoring and Reporting Program and will be monitored to ensure completion, in the same manner as the project's mitigation measures.

PDF-11 The project has been designed to be contained within a well-defined perimeter. This proposed configuration uses similar slope gradients as the existing conditions; however, the hills will be lowered and the valleys raised. The project grading makes for a more efficient project plan while still maintaining similar topographic characteristics as the existing condition.

PDF-12 The project has been designed so that home sites are situated within areas surrounded by proposed grading which allows for commonly utilized solutions to remediate potential adverse geologic conditions.

PDF-13 The project has been designed so that home sites are situated to avoid adjacency to steep unstable natural slopes; resulting in less remedial grading necessary to stabilize potential geologic hazards.

PDF-23 The project has been designed to mimic the hydrological characteristics of the site in its natural, undeveloped state through clustering the home sites, controlling development flows (runoff) with a bio-retention basin, and preserving the site's main drainage along the easterly boundary, thereby adhering to current hydromodification requirements established by the 2009 MS4 order.

PDF-24 The project has been designed to treat development flows (runoff) with a large dry extended water quality basin, while implementing the following low impact development techniques:

- Conservation of natural areas, including existing trees, other vegetation and soils.
- Keeping streets at minimum widths and eliminating paved sidewalks in parkways.
- Minimizing the impervious footprint of the project.
- Minimizing disturbances to natural drainages.

PDF-25 The project will be designed to include the following best management practices to promote infiltration and slow down surface flows:

- Impervious area dispersion.
- Native landscaping/efficient irrigation.

PDF-34 The project includes a Hydrology Analysis that demonstrates that the proposed development will not overload existing drainage facilities downstream of the

project site or exceed existing runoff velocities and volumes at discharge points for the 2-, 5-, 10-, 25-, and 100-year storm events.

PDF-35 The project includes a Conceptual Water Quality Management Plan (CWQMP) that has been prepared to identify preliminary best management practices (BMPs), which may be used on-site to control predictable pollutant runoff. The CWQMP has been based on the Orange County Drainage Area Management Plan (DAMP), Model WQMP, Technical Guidance Manual, and the County's WQMP template. The CWQMP includes the following:

- Detailed site and project description.
- A description of potential stormwater pollutants.
- Post-development drainage characteristics.
- Low impact development (LID) BMP preliminary selection and analysis.
- Preliminary structural and non structural source control BMPS.
- Preliminary site design and drainage plan (BMP Exhibit).
- GIS coordinates for all proposed LID and treatment control BMPs.
- Preliminary Operation and Maintenance Plan that: (1) describes the long-term operation and maintenance requirements for BMPs identified in the BMP Exhibit; (2) identifies the entity that will be responsible for long-term operation and maintenance of the referenced BMPs; and (3) describes the mechanism for funding the long-term operation and maintenance of the referenced BMPs.

3.5.5 Project Impacts

Impact 3.5.1: Expose people or structures to fault rupture, strong seismic ground shaking, or other seismic-related events.

Significance Standard for Impact 3.5.1: Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving: (a) strong rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area, or based on other substantial evidence of a known fault, (b) strong seismic ground shaking, (c) seismic-related ground-failure, including liquefaction, or (d) landslides?

Proposed Project

The project site does not include any Alquist-Priolo Fault Zones nor are any located in the immediate area of the project site. The nearest active fault to the project site is the San Joaquin Hills Blind Thrust located approximately seven miles from the project site. Although fault rupture is not necessarily limited to the confines of the Alquist-Priolo zone, the likelihood of rupture well outside of these zones is considered very low.

The project site is located in a seismically active region. Estimates by the Working Group on Earthquake Probabilities indicate a 97 percent chance that a magnitude 6.7 or greater earthquake will occur in the southern California region by 2037. An earthquake of this magnitude could produce strong ground shaking at the project site. A common measure of ground motion is the peak ground acceleration (PGA). The PGA for a given component of motion is the largest value of horizontal acceleration obtained from a seismograph. PGA is expressed as the percentage of the acceleration due to gravity (g), which is approximately 980 centimeters per second squared. In terms of automobile accelerations, one "g" of acceleration is a rate of increase in speed equivalent to a car traveling 328 feet from rest in 4.5 seconds. According to the geotechnical investigation, a maximum probable event could produce a PGA values at the project site ranging from 0.36g for soft rock conditions and 0.40g for alluvial sediment conditions (Pacific Soils Engineering, 2010). Ground shaking at this intensity could result in significant damage to buildings and improvements without implementation of appropriate seismic engineering. While modern design and construction practices in accordance with current building codes can effectively reduce potential damage related to geologic conditions, potentially significant impacts could occur.

The County requires that all construction meet the latest standards of the CBC for construction in seismic hazard areas. The analyses would be in accordance with applicable County ordinances and policies and consistent with the most recent version of the CBC, which requires structural design that can accommodate ground accelerations expected from known active faults. In addition, the investigations would determine final design parameters for the walls, foundations, foundation slabs, and surrounding related improvements (utilities, roadways, parking lots and sidewalks). Compliance with these building safety design standards would reduce potential impacts associated with ground shaking to less than significant levels.

Secondary seismic hazards such as liquefaction and lateral spreading generally occur when underlying materials consist of loose saturated cohesionless soils that essentially become liquefied when agitated by significant ground shaking. According to the geotechnical report for the project site, there are no known areas considered highly susceptible to liquefaction and lateral spreading based on mapping in accordance with the Seismic Hazards Mapping Act (Pacific Soils Engineering, 2010). However, localized areas of relatively shallow groundwater where loose alluvial deposits may be present at the project site that could have the potential for liquefaction (Pacific Soils Engineering, 2010).

As noted above, three landslides have been mapped within the project site (Pacific Soils Engineering, 2010). Each of these appear to be relatively shallow, and are probably the result of single or multiple debris flow type events that result from the down slope movement of highly weathered, near surface bedrock and soils. In addition, the loss of vegetation as a result of the relatively recent wildfire has likely increased the potential for landslides. While deep-seated seismically induced landsliding is not anticipated at the project site (Pacific Soils Engineering, 2010), there is still the potential for significant impacts related to steep slopes and landsliding. Project Design Features PDF-11 though PDF-13 require site design that would maintain similar topographic characteristics of the site, site homes to remediate any potential adverse geologic conditions, and situate residences to avoid adjacency to steep unstable slopes. These project

design features would effectively reduce impacts related to landsliding; however, there would still be the potential for significant geologic impacts to occur.

Although the proposed project would be subject to potential seismic hazards including ground shaking, ground failure from liquefaction, and seismically induced landslides, these potential secondary seismic hazards would be reduced to less than significant levels with implementation of geotechnical recommendations made on site specific evaluations in accordance with current building code requirements (Mitigation Measures MM 3.5-1 and MM 3.5-2).

Impact Determination: The proposed project could expose people or structures to substantial adverse effects related to fault rupture, strong seismic ground shaking, or other seismic related ground failure, including liquefaction and landsliding. Project Design Features PDF-11 though PDF-13 would reduce impacts related to landsliding. In addition, Mitigation Measures MM 3.5-1 and MM 3.5-2 would reduce significant impacts related to geologic hazards to less than significant.

Non-Clustered Scenario

The non-clustered scenario contains similar seismic hazards to the proposed project. In addition, similar to that described above for the proposed project, construction would be completed in accordance with building code requirements that would minimize the potential for seismic hazards to adversely affect proposed improvements. Under the non-clustered scenario, construction could occur in areas with steeper terrain where there is more potential for landslide and rock fall hazards, and Project Design Features PDF-11 through PDF-13 would not apply. Specifically, areas that include slopes that are 1:1 (horizontal to vertical) or steeper could be susceptible to seismically induced landslides. Each individual residential lot would be required to obtain a separate geotechnical evaluation based on specific design plans and geotechnical characteristics. First and foremost, the geotechnical evaluation would determine if the desired development is feasible from a geotechnical perspective taking into account building code standards and grading measures that would be required for the access road and consideration of any other lots in the vicinity that have been developed. Many of the natural slope areas above and below proposed lots may be unstable if not engineered appropriately. Site specific geotechnical design measures such as stabilization by cut and fill, buttressing through construction of retaining walls, used of debris walls, barriers, netting of slopes and other widely used geotechnical methods that would be included in accordance with building code standards. In addition, the non-clustered scenario would be required to submit a geotechnical report (MM 3.5-1) and adhere to all recommendations (MM 3.5-2).

Impact Determination: The non-clustered scenario could expose people or structures to substantial adverse effects related to fault rupture, strong seismic ground shaking, or other seismic related ground failure, including liquefaction or landslides. No project design features would be implemented to reduce impacts related to landsliding. Mitigation Measures MM 3.5-1 and 3.5-2 would still be required, which would reduce impacts to less than significant. However, potential impacts resulting from geologic hazards would be greater than those expected for the proposed project.

Impact 3.5.2: Substantial soil erosion or loss of topsoil.

Significance Standard for Impact 3.5.2: Would the project result in substantial soil erosion or the loss of topsoil?

Proposed Project

Construction activity associated with the proposed project has the potential to result in minor wind and water-driven erosion of soils. Excavation and/or grading for the proposed project would have the potential to result in erosion during construction activities as bare soils are exposed to wind or rain. The footprint of the proposed project primarily encompasses one drainage area and limited perimeter conditions where erosion and soil loss can affect off-site properties. After completion of the proposed project the annual loss of soil and erosion would be less than the existing conditions as a result of implementation of standard erosion control measures that are required by the County as part of drainage control. These measures include features such as a retention/infiltration basin and other features that are designed to minimize off-site transport of sedimentation thereby minimizing erosion potential. The following design features have been included in the proposed project and also identified in the CWQMP (as required by Project Design Feature PDF-35):

- Conserve natural areas, including existing trees, other vegetation and soils.
- Construct streets to minimum widths.
- Minimize the impervious footprint of the project.
- Minimize disturbances to natural drainages.
- Education for property owners, tenants, and occupants including storm drain stenciling and signage.
- Activity restrictions.
- Common area landscape management.
- BMPs maintenance.
- Common area litter control.
- Employee training.
- Common area catch basin inspection.
- Street sweeping private streets and parking areas.
- Use of efficient irrigation systems and landscape design.
- Hillside landscaping.

As required by state law, the project applicant would be required to submit a Notice of Intent to comply with the National Pollutant Discharge Elimination System (NPDES) General Permit for Discharges of Storm Water Runoff Associated with Construction Activity (General Construction Permit) (see also discussion in Section 3.8, *Hydrology and Water Quality*, of this Draft EIR). In compliance with this discharge permit, a Storm Water Pollution Prevention Plan (SWPPP) would be prepared and implemented, including an Erosion Control Plan to minimize soil erosion during construction to prevent soil from washing off the construction site into storm drains and adjacent

natural habitats. Project Design Features PDF-23 through PDF-25 would serve to reduce impacts related to erosion and loss of topsoil by mimicking natural hydrological characteristics of the site and implementing LID techniques and BMPs to minimize soil disturbance. Project Design Features PDF-34 and PDF-35 require a Preliminary Hydrology Analysis and CWQMP to further identify methods to reduce overall site runoff. Additional mitigation would still be required to reduce impacts related to soil erosion to less than significant levels during construction, and Mitigation Measures MM 3.8-1 through MM 3.8-7, as described in detail in Section 3.8, *Hydrology and Water Quality*, of this Draft EIR would reduce impacts to less than significant.

Upon completion of construction, the project site would include drainage improvements such as the retention/infiltration basin and vegetated landscaping that would reduce the potential for soil erosion or loss of topsoil in accordance with requirements for post construction erosion control measures that are part of the NPDES General Construction Permit. Areas around proposed improvements would also include landscaping, which would provide protection from erosional effects that might otherwise undermine foundations or roads. Therefore, with implementation of these project design features, permit requirements, and mitigation measures presented in Section 3.8, *Hydrology and Water Quality*, of this Draft EIR, potential impacts related to erosion or loss of topsoil would be less than significant.

Impact Determination: The proposed project would include grading and development of impervious surfaces on a presently undeveloped pervious site, which would result in potentially significant impacts related to erosion and the loss of topsoil. Implementation of Project Design Features PDF-23 through PDF-25, PDF-34, and PDF-35 would reduce impacts to less than significant. In addition, Mitigation Measures MM 3.8-1 through MM 3.8-7, as presented in Section 3.8, *Hydrology and Water Quality*, of this Draft EIR would reduce impacts to less than significant.

Non-Clustered Scenario

The non-clustered scenario would include construction activities spread out in a wider geographical area. Under this scenario, the potential for soils loss and erosion is greater as homes would be located throughout several drainages and steep terrain. The non-clustered scenario also has greater perimeter areas where soil loss and erosion could occur. However, similar to that described above for the proposed project, construction of the non-clustered scenario would be required to adhere to the NPDES General Construction Permit and a SWPPP would be required to be prepared, which would include measures to reduce the potential for erosion and loss of topsoil. The non-clustered scenario would also include Project Design Features PDF-24, PDF-25, PDF-34, and PDF-35 (but not Project Design Feature PDF-23, which includes a project design that mimics the natural hydrological characteristics of the site through clustering of development). Thus, impacts related to erosion and loss of topsoil would be greater for the non-clustered scenario than for the proposed project. While the configuration of the required drainage control features would be different than the proposed project, the final design would result in potential significant erosion impacts, and mitigation would be necessary.

Impact Determination: The non-clustered scenario would include grading and development of impervious surfaces on a presently undeveloped pervious site, which would result in potentially significant impacts related to erosion and the loss of topsoil. Implementation of Project Design Features PDF-24, PDF-25, PDF-34, and PDF-35 would reduce impacts to less than significant. In addition, Mitigation Measures MM 3.8-1 through MM 3.8-7, as presented in Section 3.8, *Hydrology and Water Quality*, of this Draft EIR would reduce impacts to less than significant. However, impacts would be greater as compared to the proposed project.

Impact 3.5.3: Result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.

Significance Standard for Impact 3.5.3: Is the project located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

Proposed Project

As with the majority of Southern California, the project site is underlain by soil and bedrock units that are susceptible to various geologic stability hazards. These potential hazards, including landslides, subsidence, bedrock instability, and liquefaction hazards are described in detail in the geotechnical investigation (Pacific Soils Engineering, 2010; see Appendix F of this Draft EIR) along with standard remedial measures that would be necessary to remediate these conditions. For the proposed project, the geologic instabilities that would affect potential building areas are generally limited to within the footprint of the project perimeter. Because of the limited footprint, the potential to affect off-site properties would also be limited and can be reduced by adherence to building code requirements.

The proposed project is within a well-defined footprint, and avoidance of several potential geologic hazards (PDF-11 through PDF-13) would be achieved through the design of the project and compliance with standard building and grading code requirements. The existing slopes are generally flatter and not as high in the proposed project as compared to the non-clustered scenario. In the proposed project, most of the lots are surrounded by areas of proposed grading. Only a few of the lots are adjacent to proposed natural areas. Within the proposed project, any unstable internal slopes would be reduced during the grading process by commonly used remedial measures. The perimeter conditions shown for the proposed project would be reduced with standard earthwork grading solutions. The lots adjacent to steep natural slopes would be evaluated to determine if special remedial measures are necessary (MM 3.5-2).

The project site includes artificial fill deposits and other low density deposits that would likely require some level of geotechnical site preparations such as excavation and recompaction with either on-site soils or imported engineered fill to meet building code requirements for the proposed improvements. These potential hazards are described in detail in the geotechnical investigation (Pacific Soils, 2010; Appendix F of this Draft EIR) along with industry standard

remedial measures that would be necessary to remediate these conditions in accordance with building code requirements. Foundation design requirements as found in the most recent CBC include minimum measures for structures and other improvements. Design and construction in accordance with these requirements would ensure that any potential existing unstable materials would be improved to accommodate the proposed structure. However, the potential for off-site landslides, lateral spreading, subsidence, liquefaction or collapse would be reduced to less than significant levels through implementation of building code requirements and widely accepted geotechnical site preparations, as well as implementation of Mitigation Measures MM 3.5-1 and MM 3.5-2.

Impact Determination: The proposed project could result in on- or off-site landslides, lateral spreading liquefaction, subsidence or collapse. Project Design Features PDF-11 though PDF-13 would reduce impacts related to landsliding. In addition, Mitigation Measures MM 3.5-1 and MM 3.5-2 would reduce significant impacts related to geologic hazards to less than significant.

Non-Clustered Scenario

Similar to that described above for the proposed project, the on-site soils and bedrock are potentially unstable and susceptible to potential geologic hazards if not designed appropriately. For the non-clustered scenario, the reduction and avoidance of potential geologic hazards related to construction of the access road can be identified and completed, as the non-clustered scenario has a footprint for the access road that is well-defined. However, development of the non-clustered scenario would be highly dependent on the design of individual residential structures which cannot be predicted at this time. In some cases, the design of a desired structure may not be feasible due to the potential geologic constraints.

Many of these steep slopes are potentially unstable. Each slope would require separate analysis and possibly unique remedial solutions. In some cases, grading solutions for steep natural slopes may not be feasible. Possible remedial solutions may involve special design elements such as reinforced earth slopes, caissons to support foundations or walls, tie-backs or soil nails, or other similar proprietary methods. Often the actual geologic conditions can only be determined during the grading process when actual access to steep areas is possible.

For the non-clustered scenario, the geologic stability conditions would involve more extensive geotechnical engineering site preparations primarily due to the generally steeper terrain. In addition, Project Design Features PDF-11 through PDF-13 would not be implemented, thus increasing the potential for impacts related to geologic hazards. Under the non-clustered scenario, each individual residential lot would require a separate geotechnical evaluation based on the homeowners desired structure and use area to specifically identify and address any potential hazards that may be present. This geotechnical evaluation would primarily determine if the desired development is feasible from a geotechnical perspective. Because many of the natural slope areas above and below proposed lots may be unstable, geotechnical design measures would be required that take into account the lot owners proposed structure and pad area.

These proposed improvements would have to account for and be compatible with any adjustments already implemented for the access road and any other lots that have been developed. In some cases, it may be determined that the desired structure is not geotechnically or economically feasible with the conditions on the desired lot. Because of the steep terrain many of the future residential structures may not be accompanied by relatively flat pad areas. This may result in structures supported on caissons, and the buildings cantilevered over the natural slopes. This potential geologic hazard is considered potentially significant for the non-clustered scenario; however, the non-clustered scenario would be required to submit a geotechnical report (MM 3.5-1) and adhere to all recommendations (MM 3.5-2).

Impact Determination: The non-clustered scenario could result in on- or off-site landslides, lateral spreading liquefaction, subsidence or collapse. Mitigation Measures MM 3.5-1 and MM 3.5-2 would be required to reduce significant impacts related to geologic hazards to less than significant. However, impacts would be greater than those associated with the proposed project.

Impact 3.5.4: Located on expansive soil.

Significance Standard for Impact 3.5.4: Is the project located on expansive soil, as defined in Table 18-1-B of the California Building Code (2010), creating substantial risks to life or property?

Proposed Project

Soils with shrink-swell or expansive properties typically occur in fine-grained clay sediments and cause damage through volume changes as a result of a wetting and drying process. Structural damage may occur over a long period of time, usually the result of inadequate soil and foundation engineering or the placement of structures directly on expansive soils.

According to the geotechnical investigation conducted for the project, the materials at the site generally have a low to medium potential for expansion; however some shear areas with higher clay contents could have a higher expansion potential. Expansion potential can only be determined with a site specific geotechnical investigation which would be a standard evaluation conducted for each proposed improvement in accordance with building code requirements. Where expansive soils are found, then site-specific design criteria to mitigate potential risks due to expansive soils would be recommended and become part of the proposed project.

Impact Determination: The proposed project is located on soils that have potential for expansion. Mitigation Measures MM 3.5-1 and MM 3.5-2 would reduce significant impacts related to expansive soil hazards to less than significant.

Non-Clustered Scenario

Geologic conditions related to expansive soils are similar to those described for the proposed project. Implementation of geotechnical recommendations in accordance with building code

requirements would reduce the potential for expansive soils to have adverse effects on proposed improvements.

Impact Determination: The non-clustered scenario is located on soils that have potential for expansion. Mitigation Measures MM 3.5-1 and MM 3.5-2 would reduce significant impacts related to expansive soil hazards to less than significant.

3.5.6 Cumulative Impacts

The geographic scope for considering cumulative impacts related to geology and soils can generally be considered as the entire Orange County; however due to widely varying conditions on a site-by-site basis the impacts related to geology and soils are generally site specific. As discussed above, the project site is in a seismically active area, which is bordered by major fault systems including the San Joaquin Hills Thrust, Newport-Inglewood, Whittier-Elsinore, and San Andreas faults. No areas of Orange County are considered seismically inactive, therefore other past, present, and future projects in the County share similar seismic hazards. However, the effects of these projects are not of a nature to cause cumulatively significant effects from geologic impacts or on the soils resource.

Additionally, as discussed, implementation of site-specific SWPPPs and BMPs, required of all projects that would disturb at least one acre, would reduce erosion from the project sites. All planned projects in the vicinity of the proposed project are subject to review in separate environmental documents that would require conformance to the local grading and building code requirements, which provide mitigation of erosion and seismic hazards to less than significant levels. With implementation of existing regulatory requirements, neither the proposed project nor the non-clustered scenario would contribute to any cumulative impact for seismic hazards or related seismic events.

The geologic conditions within the project footprint of the project site and potential geologic hazards related to it are not unique for the Orange County area. Similar geologic conditions exist/existed in adjacent developed and undeveloped areas, and in most hillside areas of Orange County and Southern California. The geologic conditions present are in general not considered to be geotechnically unsuitable for construction and would not result in significant negative impacts to off-site properties.

Development of the project site would have geotechnical conditions and constraints similar to other projects in the area. The primary geotechnical constraints that require mitigation are slope stability, landslides, bedrock instability and soil expansion, compressible and collapsible soils, and possible effects of erosion. In general, mitigation of these potential hazards is through commonly performed and widely accepted mitigation methods practiced through building and/or grading code compliance in the Orange County area as previously discussed.

Impact Determination: Impacts related to geologic hazards are typically site-specific and are reduced on a project-by-project basis. Impacts on- and immediately off-site would be reduced through implementation of the project design features and mitigation measures described herein. The proposed project or non-clustered scenario would not result in a significant cumulative impact.

3.5.7 Mitigation Measures

MM 3.5-1 Prior to the issuance of a grading permit, the applicant shall submit a geotechnical report to the Manager, Permit Services, for approval. The report shall include the information and be in the form as required by the Grading Code and Grading Manual.

MM 3.5-2 The applicant shall adhere to all recommendations included in the Geotechnical Report prepared for the project.

3.5.8 Impact Determination

The proposed project could expose people or structures to substantial adverse effects related to fault rupture, strong seismic ground shaking, or other seismic related ground failure, including liquefaction and landsliding (Impact 3.5.1). Project Design Features PDF-11 though PDF-13 would reduce impacts related to landsliding. In addition, Mitigation Measures MM 3.5-1 and MM 3.5-2 would reduce significant impacts related to geologic hazards to less than significant. The non-clustered scenario would not require implementation of Project Design Features PDF-11 through PDF-13, resulting in potentially greater impacts; however, impacts would still be reduced through mitigation.

Regarding Impact 3.5.2, the proposed project and non-clustered scenario would include grading and development of impervious surfaces on a presently undeveloped pervious site, which would result in potentially significant impacts related to erosion and the loss of topsoil. The proposed project includes Project Design Features PDF-23 through PDF-25, PDF-34, and PDF-35, which would reduce impacts to less than significant. In addition, Mitigation Measures MM 3.8-1 through MM 3.8-7, as presented in Section 3.8, *Hydrology and Water Quality*, of this Draft EIR would reduce impacts to less than significant. The non-clustered scenario would not include Project Design Feature PDF-23, which requires a project design that mimics the natural hydrological characteristics of the site through clustering of development. Thus, impacts related to erosion and loss of topsoil could be greater under the no-clustered scenario than for the proposed project; however, impacts would still be reduced through mitigation.

The proposed project and non-clustered scenario could result in on- or off-site landslides, lateral spreading liquefaction, subsidence or collapse (Impact 3.5.3). Project Design Features PDF-11 though PDF-13 would reduce impacts related to landsliding for the proposed project, but not the non-clustered scenario. In addition, development of the non-clustered scenario would be highly dependent on the design of individual residential structures which cannot be predicted at this time. In some cases, the design of a desired structure may not be feasible due to the potential

geologic constraints. However, Mitigation Measures MM 3.5-1 and MM 3.5-2 would reduce significant impacts related to geologic hazards to less than significant for both the proposed project and non-clustered scenario. In summary, the proposed project can be better defined and mitigation plans formulated in the early stages of the project. The non-clustered scenario requires much more careful evaluation throughout the development process and the potential for unforeseen conditions that are difficult to mitigate is much greater.

Regarding Impact 3.5.4, the proposed project and non-clustered scenario are located on soils that have potential for expansion. Mitigation Measures MM 3.5-1 and MM 3.5-2 would reduce significant impacts related to expansive soil hazards to less than significant.

Impacts related to geologic hazards are typically site-specific and are reduced on a project-by-project basis. Impacts on- and immediately off-site would be reduced through implementation of the project design features and mitigation measures described herein. The proposed project or non-clustered scenario would not result in a significant cumulative impact.